Game Changers for California: Technology and Institutions

California Independent System Operator Symposium

September 8, 2011

Chair Robert B. Weisenmiller, Ph. D
California Energy Commission

rweisenm@energy.state.ca.us / 916-654-5036

Why Does California Need Technology Game Changers?

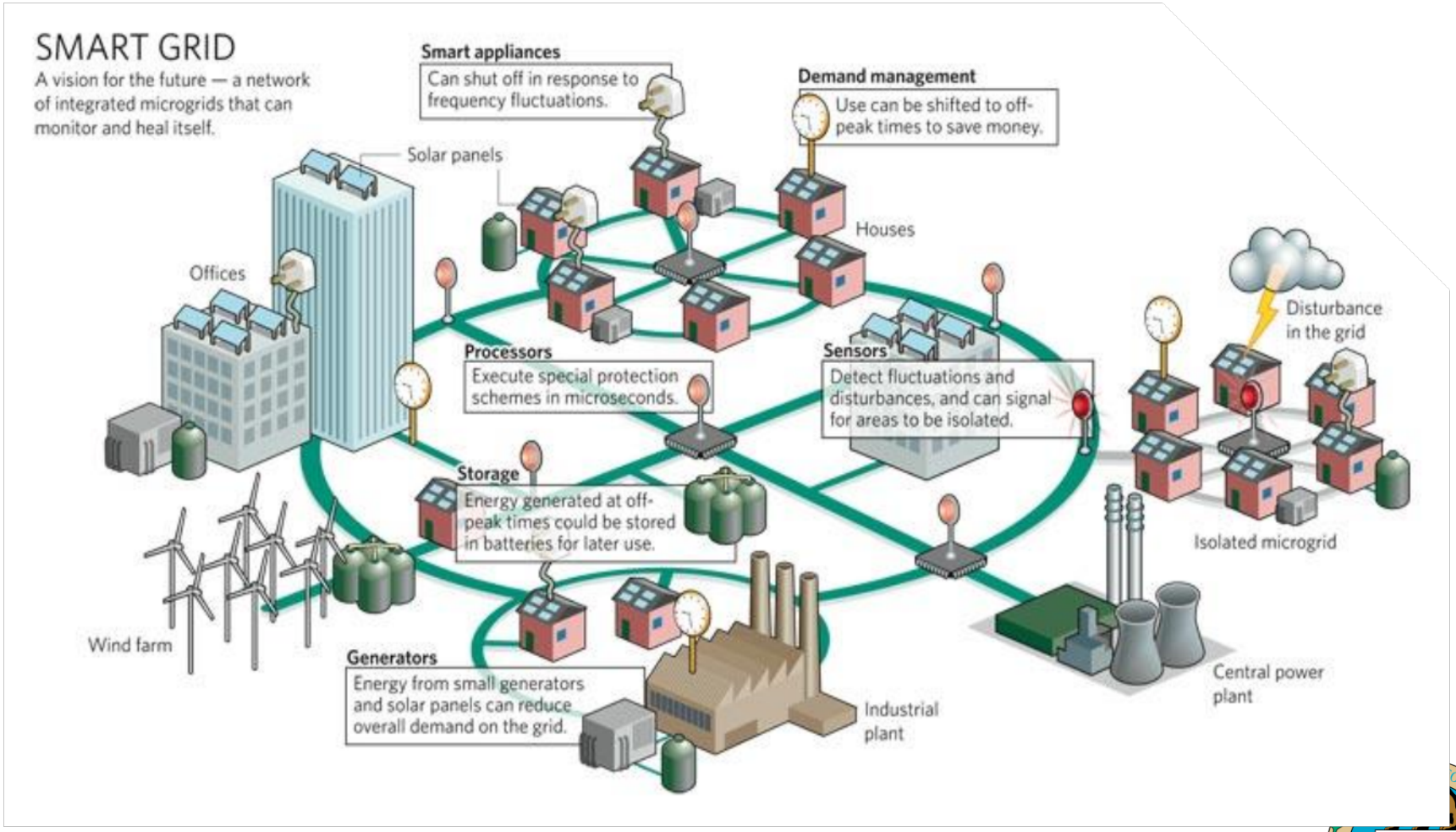
- 33% Renewable Portfolio Standard by 2020
- 12,000 MW goal for localized electricity generation by 2020
- 6,500 MW of new combined heat and power by 2030
- Increase Demand Response and Energy Storage

- Greenhouse Gas Reduction Goal of 1990 levels by 2020, including Cap and Trade
- Air quality restraints drives aggressive EV goals

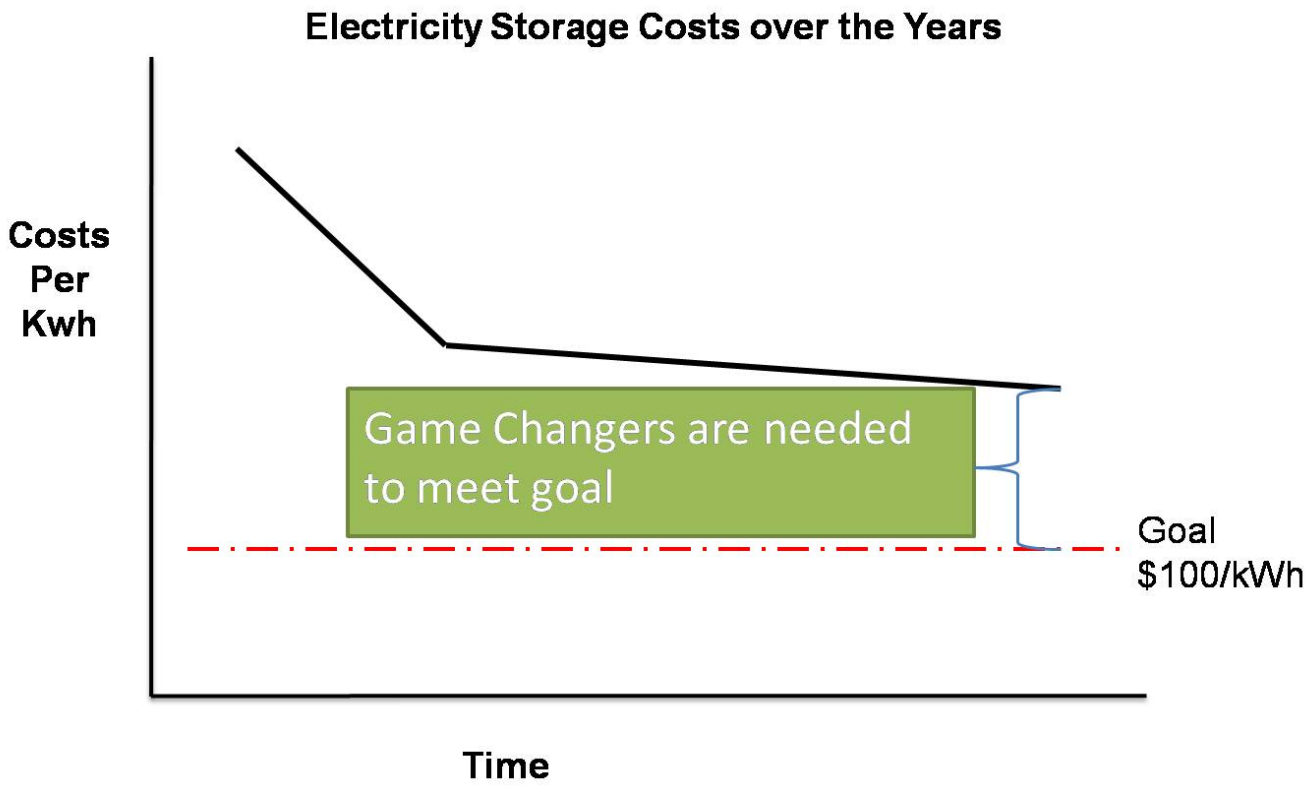
Overview of Technology Game Changers

- Components of Smart Grid Vision
- Electricity Storage
- Electric Vehicles and the Grid
- Demand Response
- Renewable Distributed Generation by 2020
- Reducing Costs of PV Systems
- Adding PV on Distribution Circuits
- Case Study: Synchrophasers

Smart Grid


SMART GRID
A vision for the future — a network of integrated microgrids that can monitor and heal itself.
Smart appliances
Can shut off in response to frequency fluctuations.
Demand management
Use can be shifted to off-peak times to save money.
Solar panels
Houses
Offices
Disturbance in the grid
Processors
Execute special protection schemes in microseconds.
Sensors
Detect fluctuations and disturbances, and can signal for areas to be isolated.
Storage
Energy generated at off-peak times could be stored in batteries for later use.
Isolated microgrid
Wind farm
Generators
Energy from small generators and solar panels can reduce overall demand on the grid.
Industrial plant
Central power plant

Electricity Storage

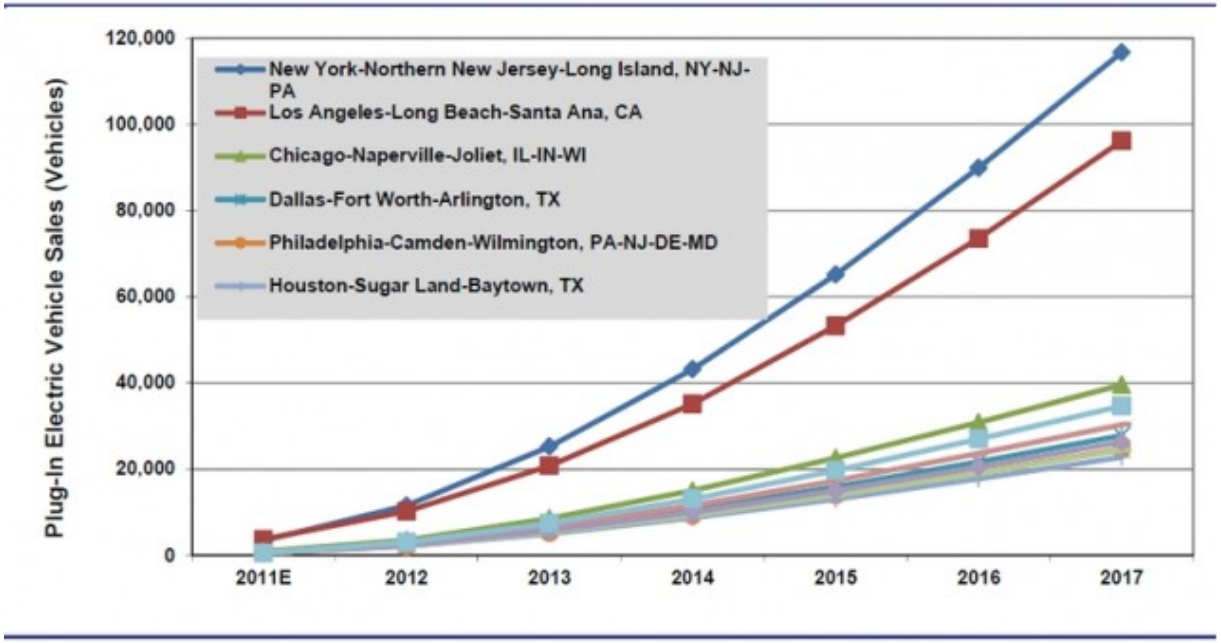


- Cost and regulations are barriers to greater use of storage
- FERC issued a NOI to address some of the regulatory barriers
- Storage combined with DR may offer a less expensive solution
- Needs both breakthroughs and economies of scale

Electric Vehicle (EV) Demand on the Distribution Grid

- Better Batteries are critical
- One EV = up to 2 houses (fast chargers can be 6.6kW)
- Clusters of EVs could overload feeders

Chart 1.2 *Cumulative Light Duty Plug-in Electric Vehicle Sales, Ten Largest MSAs by Population: 2011-2017*

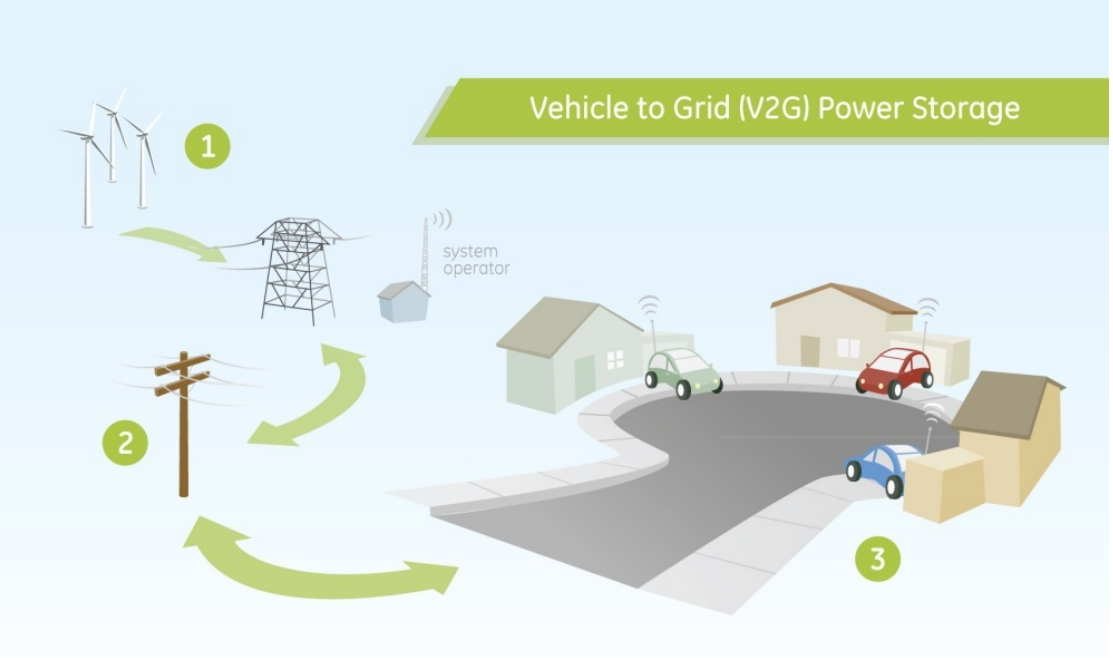


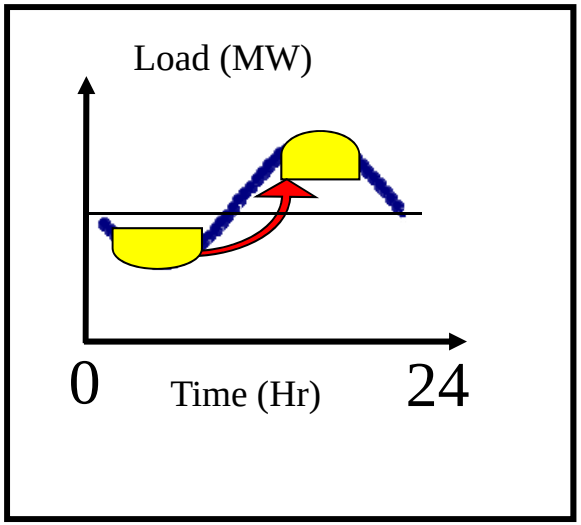
(Source: Pike Research)

A smart grid with smart charging, energy storage, and demand response may alleviate these concerns

Electric Vehicles to Grid (V2G)

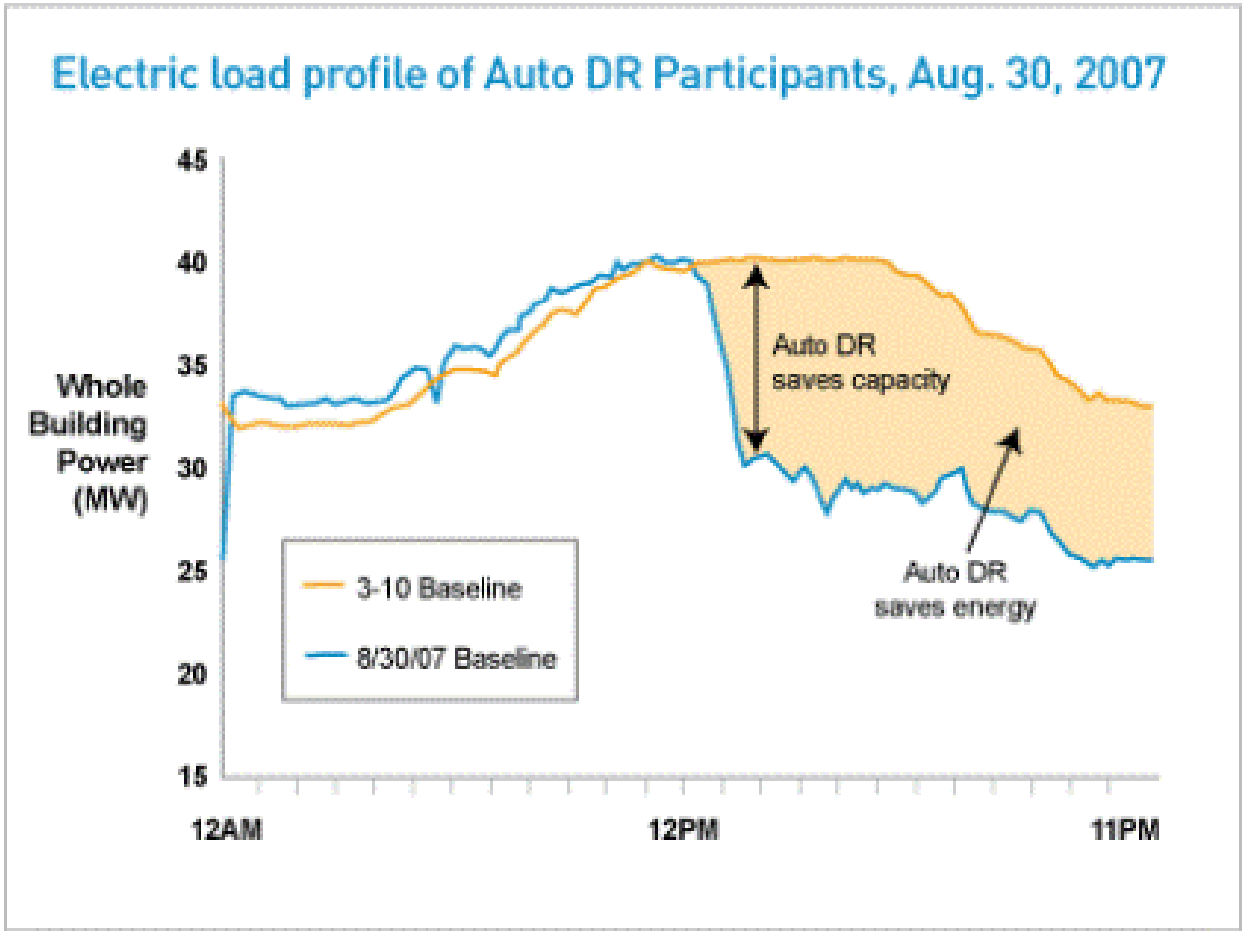
- Vehicle-to-grid technology uses parked EVs as supplemental storage on the grid





- At peak hours, consumers sell the energy stored in EV batteries back to utility companies
- AutoDR can automate this activity

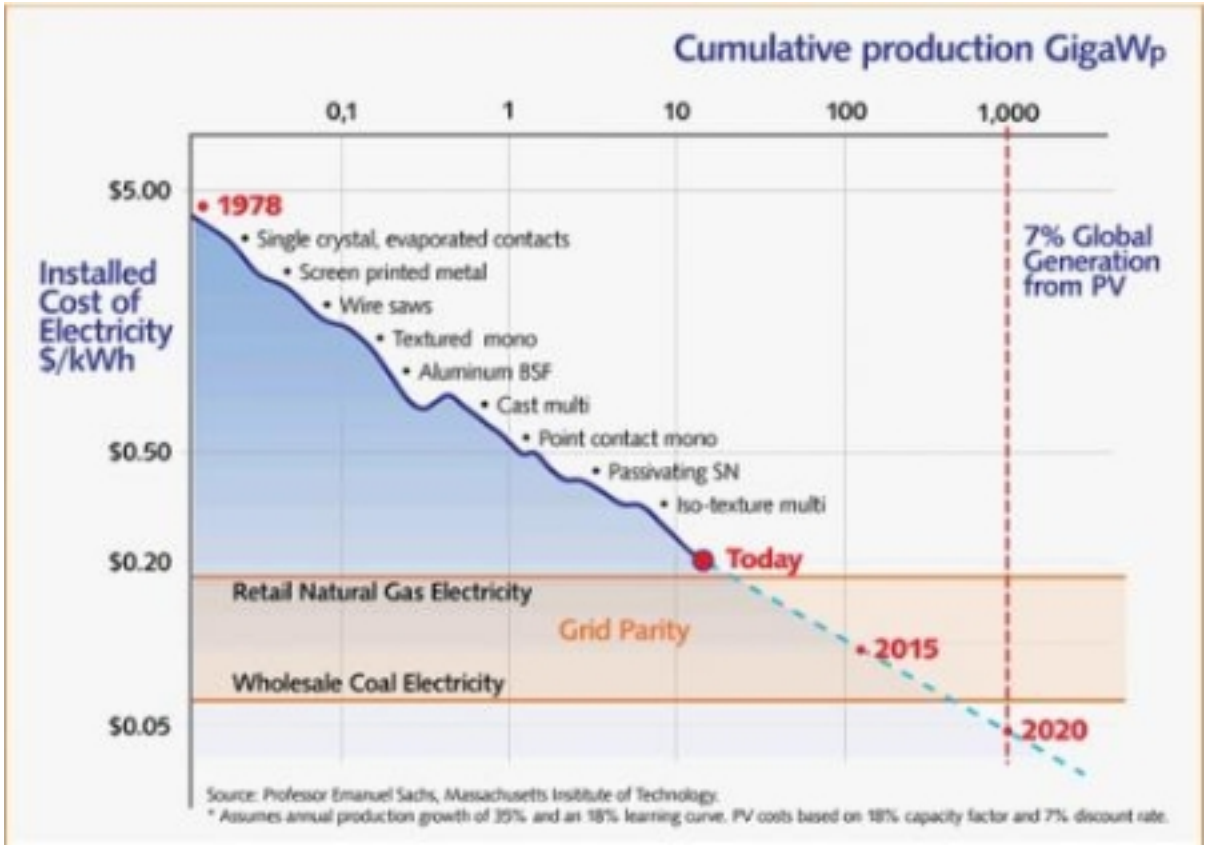
Demand Response (DR) – Automated Demand Response (AutoDR)



AutoDR occurs within seconds to minutes versus minutes to hours for traditional DR

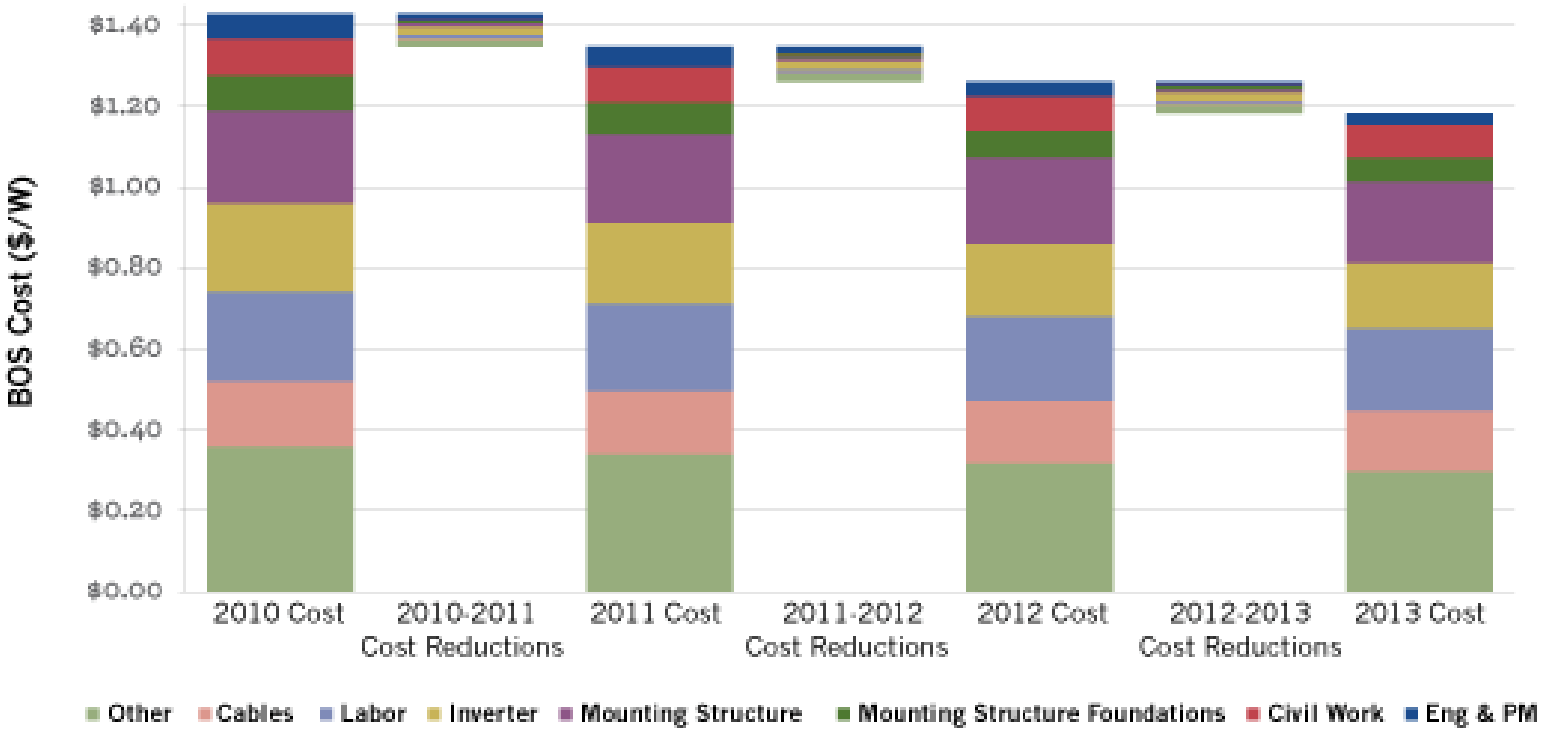
http://www.pge.com/mybusiness/energysavingsrebates/demandresponse/adrp/

Governor's Distributed Generation (DG) Goal of 12,000 MW by 2020



- PV continues to get cheaper, now at tipping point for utility scale
- California awarded **$36 million** to reduce PV costs and increase efficiencies

Solar Photovoltaics Balance of System (BOS) Cost Reduction



BOS components will be the major cost of a PV project

Lowering the Cost of PV Inverters by Reducing the Weight of the Magnetics

1200 lbs.

94 lbs.

Saves up to 90% on shipping costs and
15% on installation costs

Microinverters

215 watt Microinverter

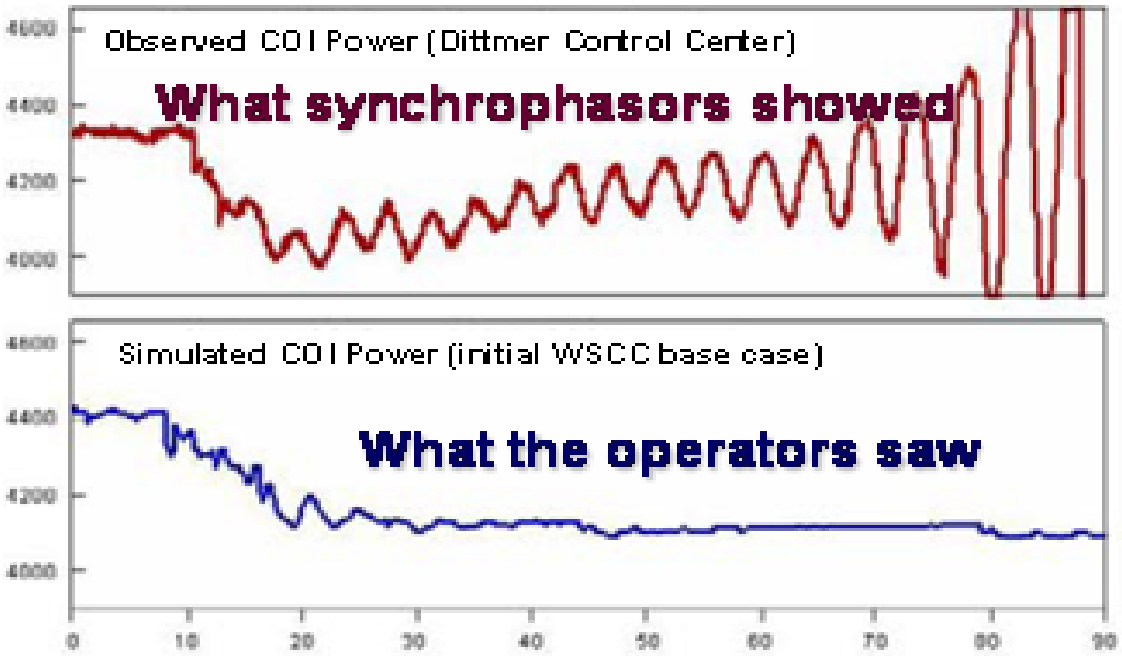
- Microinverters have already cut costs of installation by 15%
- Less wiring cuts the labor by an additional 60-70%
- Shading on one panel does not affect entire PV string

Increasing PV Capacity on a Distribution Circuit

- Max capacity of PV on a circuit is limited
- Adding smart grid functions to PV inverters increases circuit capacity
- 25%-100% more PV allowed with autonomous Volt/VAR control
- Need to replace aging distribution infrastructure with “smart grid”

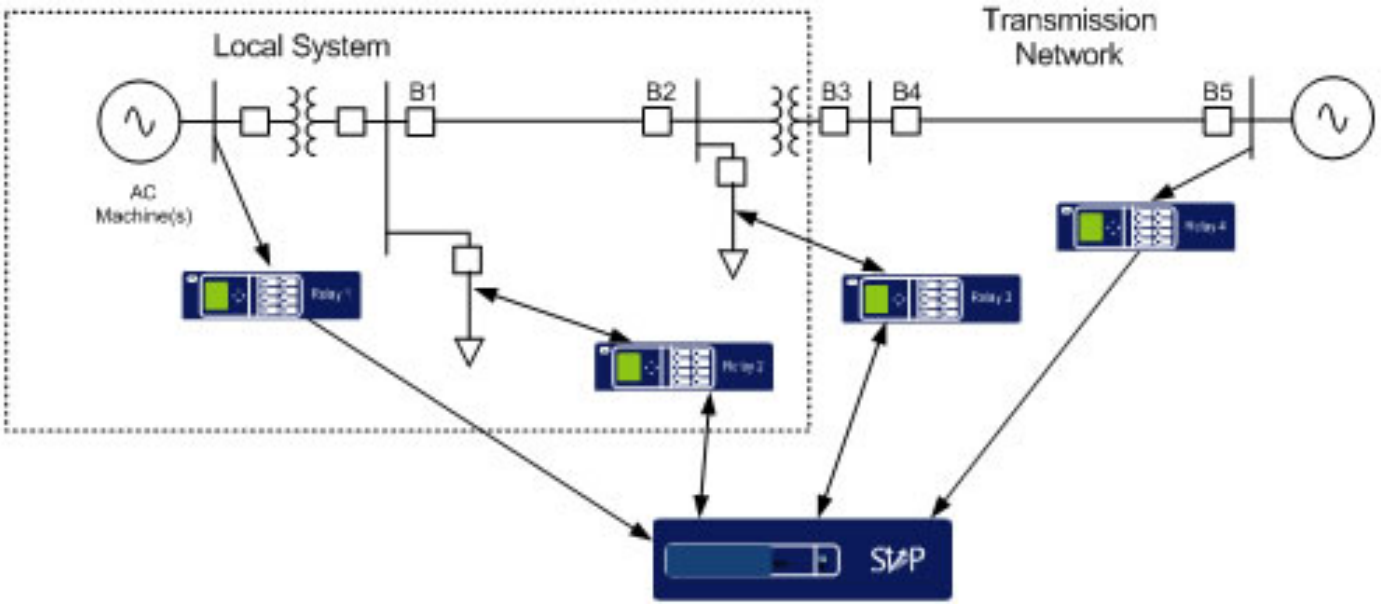
Synchrophasors
A Successful Game Changer

- From basic research through development, demonstration, and final commercialization – a 10+ year effort
- Increasing deployment will result in increasing capability



Key to Success: Involve end users, promoters and other supporters early – stakeholders will push the development to a commercial product

Next Step: Synchrophasors at the Distribution Level



- Presently used at the distribution level in a few microgrid pilots
- Increasing DG penetration will drive need for such sensors
- Ideas are being generated on how to use synchrophasors in distribution applications

Thank you!

- What are the most important potential Game Changers?
- How can we achieve such innovations?
- The goal for the break-out sessions will be to brainstorm these Game Changers
- Have fun!